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GB 2312930 A GB 2264982 A EP 0093462 A
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(54) Exhaust-gas turbocharger turbine for an internal combustion engine

(57) An exhaust-gas turbocharger turbine for an internal combustion engine is provided with a turbine housing 1, with an axially displaceable axial slide 4 which is provided with a guide-blade cascade 9 having guide blades 10 and which is guided in an annular gap 5 between the turbine housing 1 and an inner guide 6, and with a rotor 7. A radial annular space 8 is arranged between the turbine housing 1 and the rotor 7 for flow connection. In a pushed-back position, in which the radial annular space 8 is free of the guide-blade cascade 9, the axial slide 4 opens an outlet orifice 11 to a blow-off duct 12.

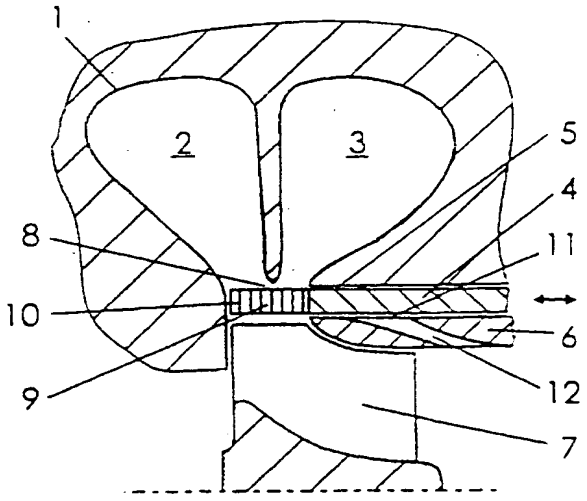

Fig. 1

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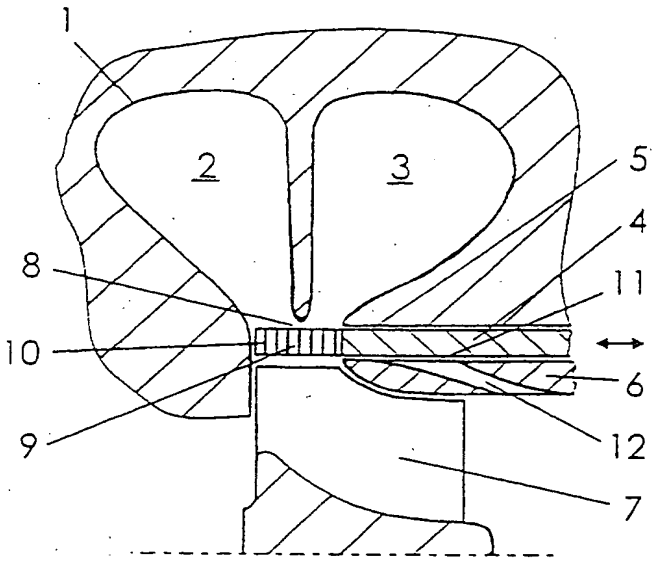

Fig. 1

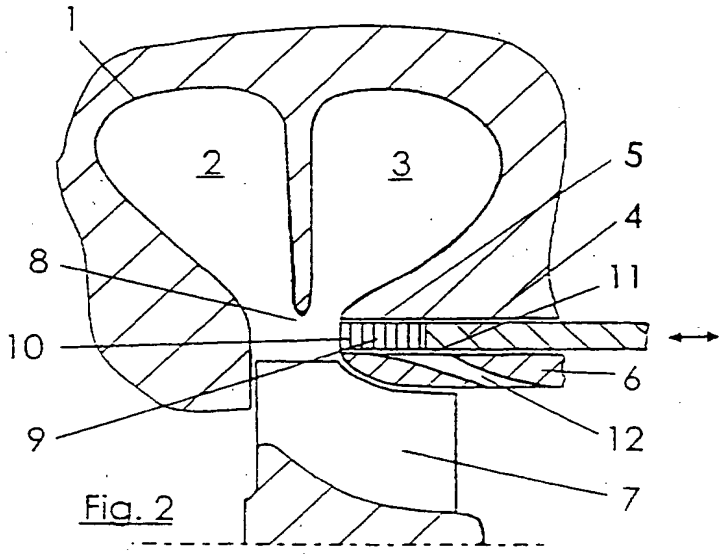

Fig. 2

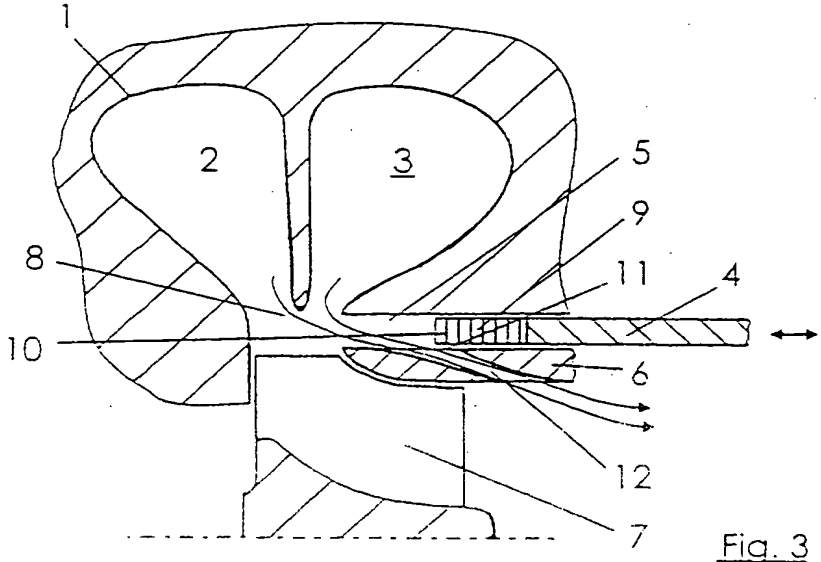

Fig. 3

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Exhaust-gas turbocharger turbine for an internal combustion engine

The invention relates to an exhaust-gas turbocharger turbine for an internal combustion engine, with a turbine housing, with an axially displaceable axial slide which is provided with a guide-blade cascade having guide blades and which is guided in an annular gap between the turbine housing and an inner guide, and with a rotor, a radial annular space being arranged for flow connection between the turbine housing and the rotor.

DE 42 32 400 C1 describes an exhaust-gas turbocharger turbine of this type in which the exhaust-gas turbocharger turbine and the exhaust-gas stream can be regulated as a function of the operation of the internal combustion engine by means of the guide-blade cascade having the guide blades. Thus, for example in the lower speed range of the internal combustion engine and in the braking mode, the guide-blade cascade is in a pushed-in position, the guide blades being located in the radial annular space. This achieves an increase in charge pressure in the downstream compressor on account of an increase in flow velocity in the turbine or in the turbine guide-blade cascade. In the medium or upper speed range the guide blades are drawn out of the radial annular space, thereby enlarging the flow cross-section. This prevents the possibility of too high a charge pressure, which could cause damage to components, being generated in the compressor. The axial slide having the guide-blade cascade provides virtually a turbine which can be operated in the two-state mode.

In the solution, described in DE 32 44 928 A1, of an internal combustion engine charged by means of an exhaust-gas turbocharger, a blow-round conduit is laid between a charge-air collecting conduit and an exhaust-gas collecting conduit. Compressed charge air is guided to the turbine inlet side by means of the blow-round conduit. Furthermore, a blow-round/blow-off device consisting of a blow-off and blow-round valve is provided.

An exhaust-gas turbocharger with a turbine housing which has a gas inlet and an axial gas outlet duct is described in DE 36 06 944 A1. In this case, a bypass conduit connecting the gas inlet and the gas outlet duct opens out in an annular recess in the wall of the gas outlet duct. An annular rotary slide serves for controlling the

bypass quantity, the said slide being arranged in the recess and containing a radial control orifice which can be brought into or out of overlap with the mouth of the bypass conduit by means of an actuating linkage.

Reference is also made, furthermore, to DE 43 15 474 C1 for the general technical background.

The present invention seeks to improve an exhaust-gas turbocharger turbine, in such a way that it has high efficiency in the braking mode, but its efficiency is also optimized as regards the generation of a charge pressure adapted to the full-load mode.

According to the present invention there is provided an exhaust-gas turbocharger turbine for an internal combustion engine, with a turbine housing, with an axially displaceable axial slide which is provided with a guide-blade cascade having guide blades and which is guided in an annular gap between the turbine housing and an inner guide, and with a rotor, a radial annular space being arranged for flow connection between the turbine housing and the rotor, wherein, in a pushed-back position, in which the radial annular space is free of the guide-blade cascade, the axial slide opens an outlet orifice to a blow-off duct.

The outlet orifice according to the invention affords virtually a three-state turbine which can thereby be set more optimally to the respective operating conditions. Thus, the guide-blade cascade will be used in a known way solely in the lower speed range of the engine for the fired mode and in the braking mode. A low absorption behaviour prevails in this case. In the second stage, namely in a medium speed range, the guide blades of the guide-blade cascade are pushed out of the radial annular space, the absorption behaviour being higher.

According to the invention, a third stage is now also provided, in which the absorption behaviour is increased even further via the outlet orifice. This range relates to the upper speed range or the load range, in which a high absorption capacity of the turbine is advantageous.

An essential advantage of this embodiment is that the turbine can consequently be designed to be altogether smaller. It can nevertheless run through a greater acceptance range. In contrast to a turbine without a blow-off device, which is designed in terms of the rated load point with a view to a nominal charge pressure and

a rotational speed adapted to its throughput, the turbine according to the invention is now designed with a smaller throughput capacity. In practice, the exhaust-gas turbocharger turbine according to the invention will be designed for a rotational speed in the medium range with regard to the nominal charge pressure. When the design point as regards its nominal charge pressure is then reached, exhaust gas is correspondingly blown off into a blow-off duct, bypassing the exhaust-gas turbocharger turbine, in order to avoid too high a pressure in the upper speed range. This prevents the charge pressure from exceeding the predetermined nominal charge pressure and possibly causing damage in the system.

Another advantage of the exhaust-gas turbocharger turbine, reduced in size according to the invention in this way, is that the nominal charge pressure is reached more quickly, as compared with conventional turbines, and that the pressure drop after the guide blades have been drawn out of the radial annular space is not as great. Due to the smaller design of the exhaust-gas turbocharger turbine, this can also be used with markedly higher efficiency in the braking mode.

A good transient behaviour of the internal combustion engine is also achieved by means of the exhaust-gas turbocharger turbine according to the invention on account of its smaller design.

Advantageous embodiments and developments of the invention emerge from the subclaims and from the exemplary embodiment described in principle below with reference to the drawing in which:

Figure 1 shows a meridian part section through an exhaust-gas turbocharger turbine of an exhaust-gas turbocharger not illustrated in any more detail, the axial slide being in the pushed-in position (1st stage),

Figure 2 shows a part section corresponding to the section illustrated in Figure 1, with a pushed-back axial slide (2nd stage), and

Figure 3 shows a part section through an exhaust-gas turbocharger turbine corresponding to the section illustrated in Figures 1 and 2, an outlet orifice in an inner guide being opened (3rd stage).

Since the exhaust-gas turbocharger having the turbine is fundamentally known, only parts essential to the invention are described in more detail below.

A double-flow turbine is illustrated in the exemplary embodiment.

However, the invention is, of course, also suitable for a single-flow turbine. The turbine has a turbine housing 1 with spiral flow ducts 2 and 3. A sleeve-shaped axial slide 4 is arranged in an annular gap 5 inside the turbine housing 1. The annular gap 5 is formed by the turbine housing 1 and an inner guide 6. The axial slide 4 can be displaced axially in the direction of the arrow via an adjusting device which is not illustrated.

A radial annular space 8 is located between the turbine housing 1 and a rotor 7. The exhaust-gas quantity flowing into the annular space 8 is influenced by the position of the axial slide 4. The axial slide 4 possesses, at its end facing the radial annular space 8, a guide-blade cascade 9 with guide blades 10 which are not illustrated in any more detail. An outlet orifice 11, which a blow-off duct 12 adjoins, is located in the inner guide 6 on the side facing the annular gap 5. The blow-off duct 12 can open into the general exhaust-gas stream again downstream of the rotor 7.

The exhaust-gas turbocharger turbine functions, then, in the following way:

Figure 1 illustrates the 1st stage, in which the guide-blade cascade 9 and therefore the guide blades 10 are pushed into the radial annular space 8. The 1st stage is used in the low speed range when the internal combustion engine, not illustrated, is in the fired mode and in its braking mode. In the medium speed range, when a predetermined nominal charge pressure is reached, in the fired state of the internal combustion engine the guide-blade cascade 9 is drawn out of the radial annular space 8 by means of a corresponding axial displacement of the axial slide 4. A lowering of the charge pressure for the downstream compressor is thereby achieved. This position is illustrated in Figure 2.

Figure 3 illustrates the position of the axial slide 4, in which, in a third stage, the latter is in a position drawn back even further. As is evident, in this position the outlet orifice 11 to the blow-off duct 12 is opened completely, so that exhaust-gas guided into the flow ducts 2 and 3 is blown off via the annular gap 5. A limitation of the charge pressure is thereby achieved. Transitional ranges, that is to say continuous operation, particularly between the positions illustrated in Figures 2 and 3, are, of course, also possible within the scope of the invention.

Instead of the orifice 11 being opened automatically by means of an axial

slide 4 pushed back into a third stage, the outlet orifice 11 may, if appropriate, also be in the inner guide in such a way that, as early as in the 2nd stage, there is a connection to the annular gap 5 and therefore to the radial annular space 8. In this case, however, a separate device is required, for example a shut-off slide which, when actuated appropriately, then opens the blow-off duct 12.

Furthermore, it is not absolutely necessary for the outlet orifice 11 and the blow-off duct 12 to be located in the inner guide 6. It is essential merely that an additional stage, with the guide-blade cascade 9 pushed back, be provided, in which exhaust gas is conducted via the annular gap 5, bypassing the rotor 7 of the exhaust-gas turbocharger turbine.

Claims

1. An exhaust-gas turbocharger turbine for an internal combustion engine, with a turbine housing, with an axially displaceable axial slide which is provided with a guide-blade cascade having guide blades and which is guided in an annular gap between the turbine housing and an inner guide, and with a rotor, a radial annular space being arranged for flow connection between the turbine housing and the rotor, wherein, in a pushed-back position, in which the radial annular space is free of the guide-blade cascade, the axial slide opens an outlet orifice to a blow-off duct.

2. An exhaust-gas turbocharger turbine according to Claim 1, wherein the axial slide is movable back a further stage in the axial direction out of the pushed-back position, in which the radial annular space is free of the guide-blade cascade, the outlet orifice being opened.

3. An exhaust-gas turbocharger turbine according to Claim 1 or 2, wherein the outlet orifice and the blow-off duct are arranged in the inner guide.

4. An exhaust-gas turbocharger turbine for an internal combustion engine, substantially as described herein with reference to, and as illustrated in, the accompanying drawings.

Amendments to the claims have been filed as follows

1. An exhaust-gas turbocharger turbine for an internal combustion engine, with a turbine housing including an inner guide and there being an annular gap between said turbine housing and inner guide, an axially displaceable axial slide which is provided with a guide-blade cascade having guide blades and which is guided in the annular gap, and a rotor which is in flow communication with the turbine housing by means of a radial annular space, wherein the axial slide is positionable to a pushed-back position so that the radial annular space is free of the guide-blade cascade and an outlet orifice in downstream flow connection with the radial annular space and leading to a blow-off duct is opened.

2. An exhaust-gas turbocharger turbine according to Claim 1, wherein the axial slide is movable in the axial direction in a multistage operation where the axial slide is movable in one stage to a first pushed-back position where the radial annular space is free of the guide-blade cascade, and the axial slide is then movable in a further stage to a second pushed-back position where the outlet orifice is opened.

3. An exhaust-gas turbocharger turbine according to Claim 1 or 2, wherein the outlet orifice and the blow-off duct are arranged in the inner guide.

4. An exhaust-gas turbocharger turbine for an internal combustion engine, substantially as described herein with reference to, and as illustrated in, the accompanying drawings.

The Patent Office

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Claims searched: all

Examiner: Ian Philpot
Date of search: 26 February 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): F1T (TDX, TFDB, TGCA, TGD)

Int Cl (Ed.6): F01D (9/06, 17/02, 17/04, 17/08, 17/12, 17/14, 25/24, 25/30); F02B (37/12, 37/22); F02C (9/16, 9/18)

Other: Online WPI (Questel)

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2264982 A	(MERCEDES-BENZ) See figs	-
A	GB 2312930 A	(MERCEDES-BENZ) See figs	-
A	EP 0093462 A	(BROWN BOVERI...) See figs	-
A	EP 0051125 A	(PORSCHE) See figs 2, 3	-
A	US 4499732	(HOLSET ENG) See figs	-
A	DE 3244928	(MASCH. AUGSBERG-NURNBERG..)	-

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